REMARKS

Entry of the foregoing amendment and reconsideration of this application are requested. Claims 1, 10 and 27 are amended, claims 20, 25, 26 and 28 are cancelled and claims 1-19, 21-24 and 27 are now pending in the application.

Claim 10 has been amended to delete the term "isomorphic" to rectify the objection of the Examiner.

The Examiner has applied Keele Jr. (US Published Patent Application Serial No. 2004/0240697) in rejecting claims 1-28, either as being anticipated under 35 USC §102(e), or as being obvious in view of the combination of Keele Jr. with Lehman (US Patent No. 6,112,847).

It is respectfully submitted that the citation of Keele Jr. is improper. Applicant is entitled to the date of the priority British application 0306415.1 filed March 20, 2003. The earliest possible prior art date for the Keele Jr. publication is May 27, 2003, the filing date of the provisional application. As such, there is no need to discuss Keele Jr. and Lehman, and it would appear that because no other prior art has been applied, that claims 1-28 would be allowable.

However, Applicant submits herewith a Supplemental Information Disclosure Statement (IDS) based on three patents cited in an Examination Report of April 4, 2007 for the corresponding European application, the most pertinent citation being US Patent No. 5,750,943 to Heinz et al. The requisite fee under 37 CFR 1.17(p) accompanies the Supplemental IDS. The claims of the subject application are amended to distinguish the present invention clearly from Heinz et al. The following comments are made relative to the amendments made in the subject application and to the Heinz et al reference.

The first novel feature in amended claims 1 and 27 is that the loudspeaker array is a mid-range array with a frequency range from 250Hz to 8KHz. The lower limit for this range may be found in the previous claim 20 whereas the upper limit for this range may be found in the top two lines of page 5. This is clearly a novel feature as there

is no disclosure in Heinz of any explicit frequency range. Indeed, Heinz appears to be attempting to provide a full range system (as stated in the paragraph beginning at column 6, line 8) with a frequency range which is presumably intended to extend above and below that defined in our amended claims 1 and 27.

The second novel feature in the amended claims 1 and 27 is that each of the loudspeakers comprises a cone diaphragm driver. Explicit support for this may be found in the third paragraph on page 10 of the specification, particularly in the second line thereof. This feature is not disclosed in Heinz. Although the description of Heinz is silent on the type of driver which is being used for each loudspeaker, the drawings imply that a compression driver is intended. It is submitted that this would be understood by the person of ordinary technical skill when considering the disclosure of Heinz, particularly because horn loudspeakers normally use compression drivers unless explicitly defined otherwise.

The third novel feature of the amended claims 1 and 27 is that each line of loudspeakers comprises a line source. The term "line source" is being used in its well-understood context to refer to a line array of interacting loudspeakers. As explained hereinafter, Heinz does not provide a line source as the individual loudspeakers are specifically intended not to interact with each other.

The fourth novel feature defined in the amended claims 1 and 27 is that the propagation axes of pairs of adjacent loudspeakers subtend an angle less than or substantially equal to 10°. Heinz disclose a much larger angle of 40°. The choice of subtended angle is not arbitrary, but has been chosen by Heinz to avoid interaction whereas the choice of an angle of 10° or less has been chosen specifically to provide interaction, as described hereinafter. Thus, Heinz specifically teaches away from the range of the present invention.

The fifth novel feature is that the "horizontal" dispersion pattern angle is less than 60°. Heinz discloses an angle equal to 60°.

As indicated in the introductory part of the subject application, the present invention is concerned with avoiding the disadvantages of conventional line source sound reinforcement systems. The present invention is also concerned with providing a system which can provide even coverage over a relatively large area, including relatively large distances, from a single location. Heinz is concerned with the problem of the effects of interaction, as would occur with line source systems and as described in the introductory part of the present specification. However, the solution provided by Heinz differs radically from that of the present invention.

Heinz is specifically concerned with minimizing or eliminating the interference created by an array of loudspeaker horns, as explicitly stated at column 4, lines 7-9 of Heinz. This is further confirmed in the passages in Heinz at column 5, lines 20-23 and column 6, lines 15-20. Heinz attempts to achieve this by prolonging the directivity of a horn-loaded loudspeaker. This is achieved by the design of horn waveguide as mentioned in column 5, lines 63-64. In particular, Heinz provides a front waveguide which, both vertically and horizontally, extends back to a common "acoustic origin" shown at 54 in the drawings of Heinz. The front waveguide is coupled to the driver by a rear waveguide which curves into the driver from transition points. The horn flare thus tapers in the opposite way from conventional horn flares. This is intended to provide a well-controlled dispersion pattern from the mouth of the horn such that sound is constrained to be emitted within the directions of the front waveguide walls.

In order to cover a relatively large audience area, the loudspeakers of Heinz are arranged as groups such that the individual loudspeakers do not interact with each other, at least throughout the frequency range where the dispersion patterns are controlled by the horn waveguides. Thus, the loudspeaker arrays provided by Heinz are not line sources because of the absence of interaction; interaction between loudspeakers is intrinsic and essential to line sources.

In practice, horn waveguides of adjacent loudspeakers arranged as disclosed in Heinz control the dispersion pattern down to a lower frequency limit. This is well

known in the field of loudspeaker design and is acknowledged in the paragraph beginning at column 6, line 8 of Heinz. Below this lower frequency limit, the dispersion pattern is no longer controlled or, to be more accurate, becomes progressively less controlled with decreasing frequency, so that the loudspeakers no longer act as independent loudspeakers providing an acoustic output into separate areas. Instead, the loudspeakers interact with each other and this has a very significant effect throughout the nominal dispersion angle provided by such a system. As stated in the sentence beginning at column 6, line 16 of Heinz, the solution according to Heinz is to provide a horn which transmits low frequency sounds less efficiently, "thus reducing undesirable coupling of the low frequency sounds". However, this description of the mechanism of operation is fundamentally incorrect. In particular, despite any reduction in output at lower frequencies, the loudspeakers will interact with each other.

The effect of this interaction is actually to reduce the dispersion pattern angle at lower frequency. In fact, the loudspeakers begin to act more like a line source and this results in "beaming" of the low frequency sound, with the possible generation of side lobes, such that there is a very uneven, frequency varying, angular distribution of low frequency sound. In particular, in the frequency range where the loudspeakers are not substantially interacting, the loudspeakers are assembled together such that their dispersion patterns are like adjacent sectors of a circle. For a vertical dispersion angle of 40° as mentioned in Heinz, arranging three loudspeakers as a vertical array would provide a vertical dispersion angle of coverage of about 120° for the frequency range where the loudspeakers are not interacting. However, at lower frequencies where interaction becomes very significant, the resulting dispersion pattern will have a primary lobe with a dispersion angle much less than 120° and with the possibility of side lobes being generated on either side of the primary lobe. The shape of such lobes will also vary with frequency. Low frequency sound coverage will therefore be highly uneven within the audience area covered by such a system which, for loudspeakers arranged vertically, will result in uneven coverage with distance. Thus, although even frequency response of

sound distribution may be achieved at one or a few distances within the "service area", there will be major unevenness in the frequency response at most distances from the vertically arranged loudspeakers.

In practice, the loudspeakers disclosed by Heinz will typically provide a well-controlled dispersion pattern down to about 1KHz when using the largest compression drivers available having the lowest frequency extension. Below this frequency, the above interaction effects will increase progressively with reducing frequency such that sound dispersion for one octave below that frequency, i.e. around 500Hz, will be highly uneven. This mechanism has been overlooked by Heinz and his loudspeaker system will perform very poorly and will fail to provide adequate performance throughout the frequency range which he implies will be covered.

In practice, such compression drivers would not be used to reproduce frequencies below about 1KHz because sound output would fall dramatically and such drivers would be destroyed by trying to reproduce such frequencies. This is avoided in practical systems by using crossover filters to prevent such low frequencies from being supplied to compression drivers.

Even if the system disclosed by Heinz were modified to use drivers which were capable of producing lower frequencies, the disadvantages in Heinz would remain. This is because the problems caused by interaction at lower frequencies as described above are caused by the horns and not by the drivers.

Whereas Heinz is specifically attempting to avoid interaction between loudspeakers, the present invention is specifically intended to make use of this so as to provide improved performance. The lines of loudspeakers according to amended claims 1 and 27 of our application are specifically arranged as line sources with the propagation axes of adjacent loudspeakers subtending an angle of less than or equal to 10° in order to provide the desired interaction for the line source mechanism to preserve the vertical dispersion angle at lower frequencies.

In the frequency range where interaction is occurring, the loudspeaker array of the present invention is taking advantage of the interaction to provide an appropriate degree of beaming of the sound so as to allow distant as well as local regions in a large area to receive a similar sound level. For relatively high frequencies where the interaction is relatively small, the beaming effect caused by the interaction may well be less, but nevertheless, the loudspeakers are supplying sound within a more tightly controlled dispersion pattern to provide similar sound levels at distant and local regions. As the frequency falls, greater interaction between the loudspeakers occurs. This has a result of concentrating sound by the beaming effect of the line sources so that, instead of distributing lower frequency sound throughout an uneven vertical dispersion angle, the beaming effect maintains the same or substantially the same vertical dispersion pattern. Thus, distant and local regions receive similar sound levels and, at each region, the sound level is consistent or even across the whole frequency range covered by the loudspeaker array.

In practice, this allows a very large extension in the frequency range which may be covered by the array. If the individual loudspeaker dispersion patterns are beginning to increase below about 1KHz, as would typically be the case for a practical loudspeaker array (for example, using typical practical horn loading), the interaction and beaming effect maintains the desired vertical dispersion pattern down to around 250 to 300Hz. In other words, the performance of the loudspeaker array is extended downwardly by about two octaves with substantially the same vertical dispersion angle or pattern and with even frequency response and sound level being maintained throughout the service area both above the frequencies where interactions begin to dominate and below these frequencies. The present invention therefore provides a loudspeaker array which operates in a substantially different mode from that disclosed by Heinz and which provides a greatly improved performance, particularly with regard to performance at lower frequencies.

Based on the foregoing, it is submitted that the pending claims all patentably distinguish over all known prior art. Accordingly, the Examiner is requested to pass this application to issue with claims 1-19, 21-24 and 27 being allowable.

Respectfully submitted,

ANDRUS, SCEALES, STARKE & SAWALL, LLP

William L Falk

William L. Falk
Reg. No. 27,709

100 East Wisconsin Avenue, Suite 1100
Milwaukee, Wisconsin 53202
Telephone No. (414) 271-7590
Attorney Docket No.: 248-00290